14.6 CONTRASTING CHARACTERISITICS OF THE 1993 AND 1994 EAST ASIAN SUMMER MONSOON: OBSERVATION AND SIMULATION

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1. Introduction

East Asian summer monsoon in 1993 and 1994 exhibits contrasting characteristics, which result in the 1993 drought in Taiwan and the 1994 drought in Japan (figure 1, upper panel), respectively. During July and August 1993, an anomalous anticyclonic circulation and below-normal precipitation over Taiwan and the Philippine Sea, and an anomalous cyclonic circulation and above-normal precipitation over Japan. In 1994, the reversed situation is observed: an anomalous anticyclonic circulation and below-normal precipitation over Japan, and an anomalous cyclonic circulation and above-normal precipitation over Taiwan and the Philippine Sea. The most contrasting sea surface temperature anomalies (SSTA) were observed in the extratropical Pacific in a zonally elongated area extending from the Japan Sea eastward to well beyond the dateline. The relationship between the SSTA and circulation anomalies is different from that often observed in the tropics. For example, the cyclonic (anticyclonic) circulation anomaly is located above the negative (positive) SSTA in 1993 (1994).

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2. Atmospheric effects on the ocean

The anomalous atmospheric circulation and surface heat fluxes several months before the appearance of the extratropical SSTA were in a distribution that can result in the increase and drop of the SST in 1993 and 1994, respectively. While the anomalous atmospheric circulation in the extratropical Pacific during the spring and early summer might lead to the changes in SST, whether the SSTA contributed to the anomalous atmospheric circulation and precipitation is another interesting question.

3. Oceanic effects on the atmosphere

The NTUGCM and ECHAM4 were used to simulate the contrasting 1993 and 1994 summer monsoon in East Asia. The NTUGCM was able to simulate the contrast to some extend (figure 1 , lower panel). However, the significant difference between the ten ensemble members indicated that the different initial conditions could result in fluctuations larger than those forced by the anomalous SST. Interestingly, the ECAHM4 produced precipitation and circulation anomalies that were in opposite phase to the observed (figure 1, middle panel). Why does the same SSTA force different responses in different GCM? It remains an unanswered question and points

out an important issue: Are the effects of the subtropical and extratropical SSTA correctly represented in most of the GCM?

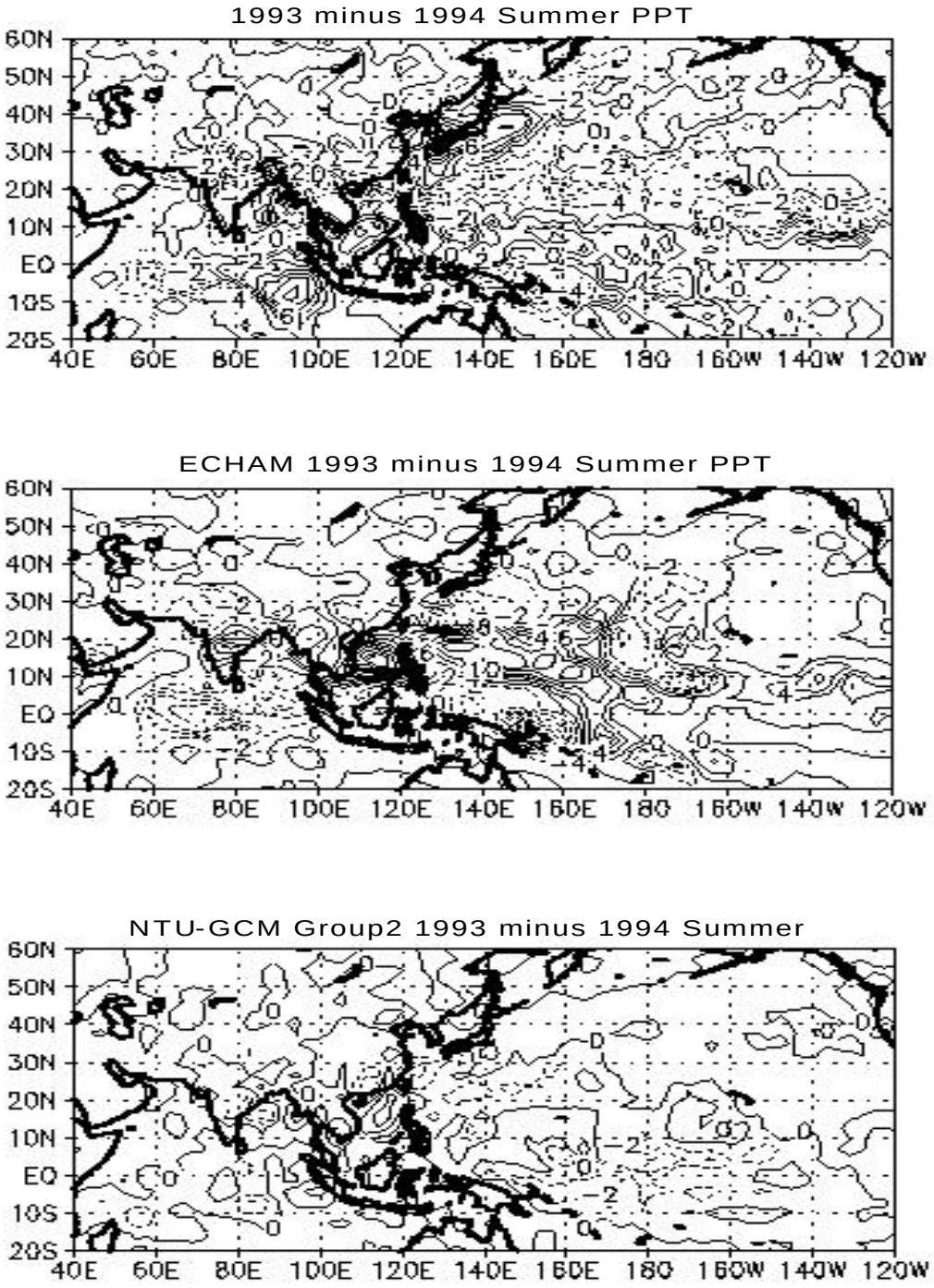

Figure 1. Precipitation difference between the 1993 and 1994 summers based on (a) CMAP, and simulations by (b) ECHAM4 and (c) NTU GCM. Solid and dashed lines indicate positive and negative anomalies, respectively. Contour interval is 1mm/day.